Innovation and intellectual capital

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Abstract

Today in an extremely fierce and global competition, companies more than ever need some proven advice how to enhance innovation. Literature proposes intellectual capital as a source of competitive advantage that can eventually lead to higher innovation. Drawing on literature from creativity, innovation management and intellectual capital we propose a four component model of intellectual capital and prove its validity. We prove that indeed intellectual capital fosters innovation but it is by no means an easy or linear process. The analysis also shows significant interrelation proving that intellectual capital is indeed a complex construct.

Keywords: Innovation, Intellectual Capital, GMRG V

Introduction

Innovations are important for several reasons; strategic reasons - they enhance market share and financial reasons - additional stream of revenues as well as enhancing sales from existing products. Product innovations are usually accompanied by process innovations which in turn can lower manufacturing costs and enhance quality through better precision. But, literature on innovation management has still no recipe for enhancing innovation. Some authors say that in order to enhance innovation, creativity has to be spurred by adequate organizational culture. Others say that that innovation will be the result of removing organizational barriers to innovation. These views, however, look at innovation only from the internal "company's" side. Innovation is more complex than that. Literature proves that external relations of company's employees with their buyers and suppliers are equally if not more important than organizational culture that fosters innovation. Another stream of literature proves that the market value of the company is far greater (or less) than its bookkeeping value. This difference in value they call intellectual capital, and state that it is exactly this intangible value that drives the value difference. This intangible value is the investor's belief in ability of the company to drive growth. It is the value of people in the company, their human capital, structural capital and social relationships inside and outside of the company. They state that it is exactly this intellectual capital that drives innovation.

This work aims to test this hypothesis is intellectual capital really the driver of innovation.

If creativity was the only driver of innovation than it would be beneficial to hire as many creative people as a company can and it would strive with innovation (Çokpekin and Knudsen, 2012). However, innovation is a complex process and cannot be explained by the sum of its parts (Puccio and Cabra, 2010). There is an abundant literature stream stating that work environment is a precondition for creativity to turn into products (Sohn and Jung, 2010). This internal work conditions could be called internal social capital. Bharadwaj and Menon (2000) and Brown and Eisenhardt (1997) state that, even though not intuitive, there has to be some formal approach or structure to enhance innovation. So, for innovation some structural capital has to be present. Subramaniam and Youndt (2005) for example state that for innovation external links of the company to their buyers and suppliers will have an extremely important role. Customers and suppliers are an abundant source of ideas and information, therefore, are the basis for future problem solving skills that will lead to innovation. These external ties are called external social capital. But, the effectiveness of problem solving skills will definitively depend on knowledge and expertise of employees. Also creativity here plays an important role. So this component of innovation is called human capital.

Linking organizational capital to innovation

Intellectual capital

Subramaniam and Youndt (2005) state that it is now widely accepted that organization's capability to innovate is closely related to its intellectual capital. (Teece, 2000, 2011) says that competitive advantage of companies stems not from market position, but from difficult to replicate knowledge assets and the manner in which they are deployed. The essence of a firm resides than in its ability to create, transfer, assemble, integrate and exploit knowledge assets. Simon (1991) states that all organizational knowledge is, in fact, inside human heads. Organizations learn through learning of its members, or by ingesting new members having the necessary knowledge. Several years later Grant (1996) suggests the same; that organizations accumulate knowledge over time, learning from their members. Organizational knowledge is created through the interactions of individuals. This interaction among members was researched by Nahapiet and Ghoshal (1998). They conceptualized innovation as both an exploration and synthesis involving a process of the combination and exchange of knowledge. They are among the first to classify intellectual capital.

Bueno et al. (2004) nicely describe the evolution of the concept of intellectual capital. First was the Skandia model that encompassed only human capital and structural capital. Then in 1998. Intellectual model was presented having three constructs human capital, structural capital and relational capital. Then in 2001. KMCI model was popularized which had three components; human capital, social capital and structural capital. However, Bueno et al. (2004) commenting this third model say that it was largely based on Nahapiet and Ghoshal (1998) model with substitution of the relational capital with social capital. Further, this social capital is divided into intra-social capital and inter-social capital.

Internal social capital

Literature on intellectual capital does not explicitly measure or address the question of creativity. However, it is important. But, according to Çokpekin and Knudsen (2012) creativity will be enhanced if: members have freedom in executing their tasks, tasks are

intellectually challenging, employees have idea time, the management is proactive, there is culture of debate.
All these premises mean that in order to enhance creativity there has to be balance between freedom of employees and the level of easiness of debating ideas. Enhancing culture of debate is management's job. Also assigning intellectually challenging tasks, giving employees idea time and proactive style of management is all managers' tasks. That can be accomplished when management facilitates open debate, but in order to do so, management has to express confidence in employees behavior and intervene when problems arise. Besides that, there should be a clear support of innovation through incentive schemes. It is highly unlikely that employees will gather and share ideas if this type of behavior is not encouraged. As a consequence of supportive management's attitude towards innovation, employees will gather in informal conversation, be it for discussing innovative ideas, discussing possible solutions to a problem or for a simple social talk. These talks should not be limited to only one department as it is known that successful product launch needs collaboration from different departments (e.g. engineering, marketing, R&D). So it is extremely beneficial if employees are able and comfortable with talking to members form other departments. It has also been shown that proximity and accessibility of interaction among employees is important for creativity. E-mail or telephone calls help, but there is nothing as efficient for idea generations as personal contact. Finally, one has to be realistic and know that not all ideas are chosen for further financing. So, even with such unpopular decisions, employees should be able to talk freely and openly. This ability to talk freely and openly across organization, backed by management support is called internal social capital in line with intellectual capital literature. Even in creativity literature such as Hemphälä and Magnusson (2012) or Schilling and Phelps (2007) show that internal cooperation between employees is extremely important for innovation. Therefore it is assumed that if:

- employees engage in informal conversation,
- there is high cross-functional cooperation,
- employees are accessible to each other and
- the open discussion on hard topics is possible,

then innovation will be facilitated through organization.

External social capital

Innovation is usually recombination of different types of knowledge (Sammarra and Biggiero, 2008). In the process of innovation, then, not only internal but also external knowledge has to be assimilated and recombined. Unlike internal connections between employees who don't usually choose their peers, external ties are usually on a voluntary base. An employee will engage in such a voluntary action only if there are mutual interest and high levels of trust and reciprocity. Although trust and reciprocity is also important for internal relations among employees, but employees being in the same company, will have similar goals so this trust and reciprocity is somewhat assumed. For external social ties this trust and reciprocity is a precondition. The exchange of knowledge will start only after shared norms are established usually through a longer period of negotiation and probing the potential partner (Dhanaraj and Parkhe, 2006; Fichter, 2009). Hemphälä and Magnusson (2012) prove that social networks with outside partners enhances innovation. It should also be noted that in intellectual capital literature these external relations are called relational capital. Martínez-Torres (2006); Hsu and Fang (2009); Sydler et al. (2014) instead of using the term social capital they

use the term relational capital and define it as relationships the firms have with outside partners. Taking into account this trust, norms, willingness to cooperate with outside partners Subramaniam and Youndt (2005) believe that this external connection will benefit innovation if there is:

- common understanding with outside partners,
- shared objectives and visions,
- share common language,
- common understanding of concepts (e.g. quality, cost,…)
- similar behavioral rules and norms and
- common values and culture.

Structural capital

From the organizational viewpoint it is the output of a creative process that is important to the company (e.g. in terms of new product revenues) and not how the creative idea was obtained (Goepel et al, 2012). Scientists agree that innovation is no more sole inventor's job, rather, result of complex interactions among employees (Pérez-Luño et al., 2011; Filieri and Alguezaui, 2014). There is a conceptual difference between creativity and innovation. Creativity is one person's idea, usually very helpful in an early stage of innovation process. However, innovation is more a coordinated effort of many individuals (from inside and outside of the company). But, according to (Goepel et al., 2012) innovation will be stirred only if organizational barriers are removed. They list the following barriers: administrative rigidness, lack of interfunctional integration, insufficient flow of information and lack of resources.

Although first three barriers were discussed in previous sections and ways to overcome them, here we want to address especially the forth one, that is lack of resources. Dominant costs of innovation are R&D costs, training and adequate employees pay. If any of those are missing the most creative employees will leave the company. Companies should invest into those if they want high innovation output, even though they are not a guarantee of innovation success. Employees leave companies even if all resources are well invested. Therefore companies have to find ways to retain knowledge of employees that leave. That, on the other hand, necessities investment into knowledge management systems. But, these investments have also another positive effect, that is, knowledge is readily available and easy to share. Therefore it can be safely said that existence of knowledge databases, manuals and the like will enhance information and knowledge sharing which is important for innovation. But, in order to systemize knowledge it is necessary to have detailed work procedures in place. Especially procedures on information and knowledge capturing should be known and detailed. Therefore, a company with high innovation potential will have knowledge stored in databases as well as standard operating procedures. This will enable effortless data gathering process which is also important for innovation. Brown and Eisenhardt (1997) explain this benefit of structure, because organized knowledge and procedures make work easier and more effective. Employees are privileged by not having to "reinvent the wheel" each time. Therefore, according to Subramaniam and Youndt (2005), a company possesses high level of structural capital if:

- standard operating procedures are in place,
- much of this plant's knowledge is contained in manuals, archives, or databases,
- the employees usually follow the sequence of written procedures and rules and
- processes in the company are well defined.

Human capital

Human creativity is an important driver of innovation (Si and Wei, 2012). Epstein et al. (2013) reinforce how knowledge is important to innovation but they also state that different types of knowledge are necessary (because as it was said, innovation is a recombination of knowledge). Human capital is rooted in a certain way in the talent of employees. Human capital consists of components such as knowledge, expertise, skills, experience and competence (Sydler et al., 2014). According to Snell and Dean (1992); Subramaniam and Youndt (2005) and Lee et al. (2011) human capital will be greater if:

- there are highly skilled employees,
- employees have great knowledge and are considered as best people in the organization,
- employees are experts in their particular jobs and functions,
- employees have useful experience.

Impact of intellectual capital on innovation and hypotheses

Subramaniam and Youndt (2005) show a positive impact of intellectual capital on innovation (radical and incremental), showing that these two types of innovation will necessities different components of intellectual capital. Menor et al. (2007) prove that intellectual capital positively influences both process and product innovations. Finally, Lee et al. (2011) show a positive influence on process innovation and also replicated the Subramaniam and Youndt (2005) study showing that indeed different components of intellectual capital lead to radical and incremental innovation.

Therefore on grounds of these previous researches the hypotheses are stated.

H1: Human capital has a positive influence on innovation

H2: Structural capital has a positive influence on innovation

H3: Internal Relational/Social capital has a positive influence on innovation

H4: External Relational/Social capital has a positive influence on innovation,

where innovation is measured by a construct that is composed 6 items on a seven point Likert scale that responders had to evaluate innovation against their competitors (a measure of strategic importance of innovation).

Data collection

In order to asses such a complex issue as innovation and intellectual capital, a large database is needed. For this study the large Global Manufacturing Research Group (GMRG) V is used.

The data is a sub-sample of the round V GMRG data collection effort. The Global Manufacturing Research Group (GMRG) is an international community of researchers studying the improvement of manufacturing supply chains worldwide. The GMRG consists of leading international academic researchers from over 20 countries. These researchers developed the GMRG survey instrument to understand manufacturing practices around the world. This survey instrument facilitates a global comparison of the effectiveness of manufacturing practices (Whybark, et al., 2009). Since 1985, the GMRG has completed five rounds of the worldwide survey. The survey questionnaires for all countries is translated and back-translated by several academic researchers. When translating the questionnaire into the language of the respective country, particular attention is paid to translation equivalence of the questionnaire versions by rigorous translating and back-translating rounds by language and subject matter experts (Douglas and Craig, 1983). The unit of analysis for the survey is the manufacturing site or plant,

and all data are collected from plant managers as key informants within that site. These managers are targeted since they are deemed to possess a comprehensive knowledge of the plant's operations, in addition to having insight into related functions. The managers are advised to solicit input from other functions, such as marketing and finance, when appropriate. Data is collected by individual members of the GMRG, who are requested to apply the most appropriate approach and the most suitable population frame depending on the country-specific circumstances (Whybark, 1997). This flexibility is afforded to the researchers owing to the complexity and length of the questionnaire, often requiring the key respondent to consult with other individuals within the firm, or the compilation of historical data and the calculation of indices. As such, most questionnaires are completed during an on-site visit (43%) by the researcher, followed by Internet (29%) and mail surveys (23%) (Schoenherr and Narasimhan, 2012). GMRG survey is tested for common method bias in accordance with Conway and Lance (2010); Ota, et al. (2013).

A $\chi 2$ analysis is conducted against early and late respondents to validate for non-response bias in each country (Armstrong and Overton, 1977). As no significant differences are revealed, non-response bias is not evident. The survey instrument uses observable and perceptual measures. Past studies have demonstrated that perceptual measures are useful for empirical research that is related to managerial evaluations (Vickery et al., 1993; Klassen and Whybark, 1999).

The questionnaire has five modules, of which the Core module is obligatory and contains demographic data of the company. Other modules are elective, and the researcher that collects the data is obtaining only the data from other gatherers on modules he/she collects. The core module in round V answered 890 companies.

Control variables

Size is used as a control variable because it is believed that large organizations can potentially have more slack resources and, thus, may be able to develop more know-how or to innovate more in line with Tsai and Ghoshal (1998).

The sample

In the sample there are 890 manufacturing companies of which 25,9% are small companies till 50 employees. 47% of companies are middle sized companies (50 till 250 employees) and 27,1% of companies are large with over 250 employees. Countries in the sample are presented in Table 1.

Table 1. Descriptive statistics

Country	Count	Percent	Profit margin	Revenues from new products as % of total sales
Australia	66	7,4%	21,71	19,68
Canada	4	0,4%	24,50	13,75
China	97	10,9%	12,49	38,09
Croatia	110	12,4%	18,05	25,21
Czech Republic	1	0,1%		20,00
Germany	44	4,9%	16,33	29,55
Hungary	36	4,0%	7,72	20,60
India	57	6,4%	23,77	22,63
Ireland	30	3,4%	25,05	23,67
Netherlands	2	0,2%	24,00	12,50
Nigeria	46	5,2%	13,06	27,02
Poland	76	8,5%	-4,14	26,84
Taiwan	40	4,5%	18,28	29,85

Ukraine	48	5,4%	21,10	21,20
USA	166	18,7%	16,10	21,14
Vietnam	67	7,5%	18,14	71,62
Total	890	100,0%	14,99	28,89

As it can be seen from Table 1, in the sample are developed and developing countries, all together 16 countries. However, for the analysis country belongings is not researched.

Clustering of companies according to profit margin revealed three groups, negative, medium and high performers. However, it has to be noted too, that some performers have above average profit margins yet they have average revenues from new products as for example companies from Canada and Netherlands. It simply shows that that some companies put bigger emphasis or innovations, while others on for example quality. The overall average of innovations revenues is 28,89% of total revenues.

Results

The analysis is conducted using SPSS and AMOS. SPSS was used for descriptive analysis and assessing the Crombach Alpha reliability measures, and post hoc Harman one-factor analysis. AMOS is used for confirmatory factor analysis and evaluating the structural equation model. Table 2 presents Constructs, Measurements and factor loadings for the model.

Table 2. Constructs, Measurements and factor loadings for the model

			Estimate	S.E.	C.R.	P
Internal social capital: CR=0.882, AVE=0.656, Crombach α=0.876	ISC1	I13d	0,836			
	ISC2	I13c	0,906	0,037	26,727	***
	ISC3	I13b	0,856	0,040	24,523	***
	ISC4	I13a	0,611	0,047	15,568	***
Structural (organizational) capital CR=0.891, AVE=0.674, Crombach α=0.890	STRUCT1	I13h	0,887			
	STRUCT2	I13g	0,880	0,035	29,222	***
	STRUCT3	I13f	0,768	0,044	21,679	***
	STRUCT4	I13e	0,738	0,039	20,679	***
Human Capital CR=0.889, AVE=0.668, Crombach α=0.888	HC1	I13n	0,777			
	HC2	I13m	0,871	0,049	22,518	***
	HC3	I13l	0,799	0,054	20,020	***
	HC4	I13i	0,820	0,050	20,492	***
External social capital CR=0.905, AVE=0.614, Crombach α=0.906	ESC1	I13t	0,778			
	ESC2	I13s	0,837	0,046	22,044	***
	ESC3	I13r	0,780	0,047	19,445	***
	ESC4	I13q	0,753	0,053	18,851	***
	ESC5	I13p	0,802	0,048	20,343	***
	ESC6	I13o	0,748	0,046	18,376	***
Innovation performance CR=0.936, AVE=0.744, Crombach α=0.935	ININ1	I06a	0,819			
	ININ2	I06b	0,828	0,042	23,892	***
	ININ3	I06c	0,874	0,044	25,092	***
	ININ4	I06d	0,881	0,045	25,039	***
	ININ5	I06e	0,908	0,046	25,960	***
$\chi2$=1023,913, $\chi2$/df=4,6, p=0, IFI =0,919, CFI =0,919, RMSEA =0,061						

As it can be seen in Table 2, all threshold values are all in acceptable range ($\chi2$/df<5), IFI and CFI>0,8, REMSA<0,1 (Hu and Bentler, 1999). Composite reliability (CR) statistics indicates strong construct reliability in each case; all values are well above 0.7 (Fornell and Larcker 1981). The results established convergent validity and unidimensionality for each construct, as all item loadings (lambdas) are highly

significant (all t-values are >2.0). The results also indicated acceptable discriminant validity for the measures at both the construct and item levels. The average variance extracted (AVE) for each construct variable is greater than the squared correlation of the construct with any other construct, indicating acceptable construct discrimination (Fornell and Larcker 1981). All AVE (convergent validity) are greater >0,5 in line with Hair et al. (2010).

Common method variance is a crucial question when both the dependent and focal explanatory variables are perceptual measures derived from the same respondent. Four approaches are recommended in the literature as methods that researchers should use to avoid or correct CMV (Chang et al., 2010; Podsakoff et al., 2003) and are fulfilled in this work.

As can be seen from Table 3 and Figure 1. all components of intellectual capital have a significant positive effect on innovation. Specifically, external social/relational capital has a significant positive effect on revenues from new products and strategic importance of innovation. This can be explained as the companies with higher contacts with outside partners especially customers, get the information and ideas for new products launch. However, in order to achieve a successful launch of a product human capital expressed in knowledge and skills of employees is very important. Structural capital and internal relations among co-workers also enhance a probability of a successful new product launch. Therefore all components of intellectual capital are important because new product launch is an orchestrated effort of all employees.

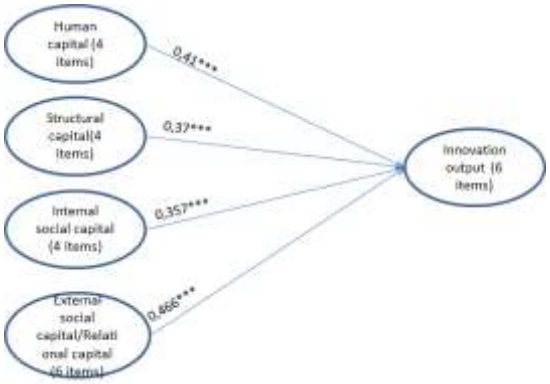

Figure 1. Model summary

Table 3. Correlations among constructs

	inn	intsc	struct	human	extsoc
inn					
intsc	0,357				
struct	0,370	0,541			
human	0,410	0,599	0,598		
extsoc	0,466	0,538	0,604	0,632	

*all correlations are significant at p=0.001 level

Standardized regression weights of each component on innovation ordered by its order of magnitude is as follows: External social/relational capital (0,466***), Human capital (0,410***), Structural capital (0,370***) and Internal social/relational capital (0,357***). This analysis shows that for innovation especially external social/relational capital and human capital are important but the analysis also shows that structural capital and internal social/relational capital are no less important. This analysis also proves all four set hypotheses.

It should be noted, however, that size has a significant effect on intellectual capital and the resulting innovations revenues in line with Tsai and Ghoshal (1998).

Conclusion

This work has proposed a four component model of intellectual capital as proposed by Bueno et al. (2004) but, such a four component model has not yet been tested. The four components are internal social capital, structural capital, human capital and external social capital. The results of the factor analysis prove the robustness of the model.
The structural equation model of intellectual capital components on innovation gives the biggest importance to external social capital, human capital, internal social capital and structural capital and magnitude of influences are in that order. All components of intellectual capital have a significant positive effect on innovation.

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